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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/927,863	08/10/2001	Hanna A. Bamnolker	10200/101	7231

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EXAMINER
UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 05/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/927,863	BAMNOLKER ET AL.
	Examiner	Art Unit
	Lynette T. Umez-Eronini	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30* is/are pending in the application.

4a) Of the above claim(s) *24-29* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23 and 30* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4*
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of April 21, 2003 in Paper No. 7 is acknowledged. The traversal is on the ground(s) that the office has failed to explain how this other method is materially different from the claimed process, nor has the office provided sufficient detail about this other process for one to determine if it is materially different. This is not found persuasive because claims 1-23 and 30 are drawn to making a semiconductor device by dry etching and are classified in class 438, subclass 706. Claims 24-29 are drawn to a silicon wafer and are classified in class 438, subclass 400. The product (a semiconductor wafer) as claimed is made using dry etching. However, the product as claimed can be made by another and materially different process, such as one that does not requires dry etching.

The requirement is still deemed proper and is therefore made FINAL.

Claim Objections

2. Claim 18 is objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim cannot dependent from any other multiple dependent claim. See MPEP § 608.01(n). Accordingly, the claim has not been further treated on the merits.

3. Claim 3 and 19 are objected to because of the following informalities:

In claim 3, "the nitride end point" lacks antecedent basis. Appropriate correction is required.

In claim 19, "CF_3" is incorrectly written. Appropriate correction is required. For the purpose of examination, CHF_3 would be searched.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 3, 4, 5, 6, 9, 10, and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al. (US 5,994,229).

Chen teaches, "Referring now to FIG. **2**, the process starts at **21** with . . . silicon body, or substrate, **2** on which is formed layer of pad oxide . . . A layer of silicon nitride **4** . . . is then laid down (see 22)," (column 3, lines 54-58). "Continuing reference to FIG. **2**, the first of several subprocesses is now used to etch away silicon nitride (see **24**):" (column 2, line 65-67). "Once the first subprocess has been terminated, the second subprocess (see **26**), which involves overetching the silicon nitride and etching through the pad oxide . . ." (column 3, lines 21-23). "The . . . first subprocess further comprises: . . . methane trifluoride (a fluorinated hydrocarbon) . . ., carbon tetrafluoride . . ., argon (inert gas) . . . , and oxygen . . . (claim 2). "The . . . second subprocess further comprises: . . . methane trifluoride, . . . a fluorinated hydrocarbon, . . . and argon . . . (claim 3). The aforementioned reads on,

A method of forming a semiconductor structure. comprising:

etching through a nitride layer;

etching through an oxide layer; and

etching a semiconductor substrate; wherein:

a last portion of the nitride layer is etched with a nitride etching chemistry comprising a fluorinated hydrocarbon, oxygen, and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof;

a last portion of the oxide layer is etched with an oxide etching chemistry that is different from the nitride etching chemistry; and

the nitride layer is on the oxide layer, and the oxide layer is on the semiconductor substrate, **as in the present claims 1 and 30;**

wherein the fluorinated hydrocarbon is selected from the group consisting of CF_4, CH_3F, and combinations thereof, **as in the present claim 4**;

wherein the oxide etching chemistry comprises a fluorinated hydrocarbon is selected from the group consisting of CHF_3, **as in the present claim 5**.

the semiconductor substrate comprises silicon, and wherein the etching of the semiconductor substrate is achieved with a silicon etching chemistry comprising a reagent selected from the group consisting of a halogen gas, a hydrogen halide, oxygen and combinations thereof, **as in the present claim 6;**

the silicon etching chemistry comprises Cl_2, HBr, and O_2, **as in the present claim 9**;

wherein the nitride etching chemistry comprises CF_4, CHF_3, Ar, and O_2, **as in the present claim 10**.

Since Chen uses the same etchant in etching and over etching the same (nitride) layer as that of the claimed invention, then using Chen's etchant and etching method would inherently overetch the nitride layer using the nitride etching chemistry by up to and including ten percent of the nitride end point, **as in the present claim 3**.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen as applied to claim 1 above, and further in view of Kim et al. (US 6,214,637 B1).

Chen differs in failing to teach an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

Kim teaches, layers that are stacked on a semiconductor wafer and that are comprised of a silicon substrate **100** and an ARC layer **106** that overlies a highly reflective layer **104**, (column 4, lines 28-41 and **FIG. 4**). "When the highly reflective layer **104** is a SiN layer, it is possible to simultaneously remove the ARC **106** and the highly reflective layer **104** by . . . oxygen, . . . argon, . . . and . . . CHF_3 . . . (column 5,

line 66 - column 6, line 6). The aforementioned reads on, an antireflective coating is on the nitride layer and wherein the method further comprises etching the antireflective coating using the nitride etching chemistry.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using an antireflective coating that is on a nitride layer and etching the antireflective coating using the nitride etching chemistry as taught by Kim for the purpose of providing a method for forming a photoresist pattern, in which the anti-reflective coating (ARC) has excellent etching selectivity, is economical to produce, and is easily removed once the photoresist pattern has been form (column 2, lines 48-52).

8. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) in view of as applied to claim 1 above, and further in view of Huang (US 6,225,187 B1).

Chen differs in failing to explicitly teach the oxide etching chemistry comprises CF_4.

Huang teaches, " . . . (e) etching the exposed hard mask and the underlying oxide layer . . ." (column 1, lines 64 - column 2, line 4). "The oxide layer consists of a silicon dioxide layer. The hard mask can be nitride selected from the group consists of silicon nitride or silicon oxynitride. The etching process applied in step (e) is dry-etching, wherein the etchant is composed of a mixture of $CHF_3/CF_4/O_2/Ar$ . . ." (column 2, lines

6-12). The aforementioned reads on, the oxide etching chemistry comprises CF_4 along with CHF_3.

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using Huang's method of etching an oxide layer comprising CF_4 and CHF_3 for the purpose etching a trench in two steps (Huang, column 2, lines 34-36) as compared to three steps as in the present invention.

9. Claims 8, 11, 12, 13, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) as applied to claim 1 above, and further in view of Bhardwaj et al (US 6,051,503).

Chen differs in failing to specify the flow rate ratio of CF_4 to CHF_3 as recited in claims 8, 11 and 15; the ratio of pressure:top power:bias of the nitride etching chemistry as recited in claims 13 and 14; ratio, and the nitride etching chemistry is introduced with a bias of at least –50 V, in claim 12.

Bhardwaj teaches. "one or more of the following parameters: gas flow rates, chamber pressure, plasma power, substrate bias, etch rate, deposition rate, cycle time and etching/deposition ratio vary with time" (Abstract), which provides evidence that variations in the gas flow rate, pressure, and plasma power and bias are so-called "result effective variable"

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using

Bhardwaj as evidence that variations in the gas flow rate, pressure, plasma power and bias are so-called "result effective variables" since it has been held that discovering an optimum value of a result effect variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 206 USPQ 215 (CCPA 1980).

10. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen ('229) in view of as applied to claim 1 above, and further in view of Kosugi et al. (US 5,723,383).

Chen differs in failing to teach cleaning the semiconductor substrate with a silicon cleaning chemistry comprising a fluorinated hydrocarbon and an inert gas selected from the group consisting of neon, argon, krypton, xenon, and combinations thereof, as in claim 16 and cleaning the semiconductor substrate using a silicon cleaning chemistry comprising CF_4 and argon, as in claim 17.

Kosugi teaches, "It is also possible to obtain cleaned substrate surfaces by dry etching using plasma formed by various reaction gases such as Ar, H_2, CF_4, . . ." (column 10, lines 45-48).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Chen by using Kosugi's method and gases to clean a semiconductor substrate for the purpose of removing unwanted etch residues from the semiconductor substrate.

Claim Rejections - 35 USC § 102

11. Claim 19-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen ('229).

Chen teaches, "Referring now to FIG. **2**, the process starts at **21** with . . . silicon body, or substrate, **2** on which is formed layer of pad oxide . . . A layer of silicon nitride **4** . . . is then laid down (see 22)," (column 3, lines 54-58). "Continuing reference to FIG. **2**, the first of several subprocesses is now used to etch away silicon nitride (see **24**):" (column 2, line 65-67). "Once the first subprocess has been terminated, the second subprocess (see **26**), which involves overetching the silicon nitride and etching through the pad oxide . . ." (column 3, lines 21-23). "The . . . first subprocess further comprises: . . . methane trifluoride (a fluorinated hydrocarbon) . . . , carbon tetrafluoride . . . , argon (inert gas) . . . , and oxygen . . . (claim 2). "The . . . second subprocess further comprises: . . . methane trifluoride, . . . a fluorinated hydrocarbon, . . . and argon . . . (claim 3). The aforementioned reads on,

A method of forming a semiconductor structure comprising:

etching through a nitride layer;

etching through an oxide layer; and

etching a semiconductor substrate; wherein:

a last portion of the nitride layer is etched with a nitride etching chemistry comprising CF_4, CHF_3, Ar, and O_2;

a last portion of the oxide layer is etched with an oxide etching chemistry comprising CF_4 and CHF_3;

the semiconductor substrate is etched with a silicon etching chemistry Cl_2, HBr, and O_2, **as in the present claim 19**.

Since Chen's method of forming a semiconductor structure is the same as that of forming shallow trenches, which are widely used in integrated circuit technology as a means for electrically isolating different parts of the circuit from each other, then using Chen's method of forming a semiconductor structure would inherently result in making a semiconductor structure, and forming a semiconductor device from the structure, **as in the present claims 20 and 22**; and forming an electronic device, which comprises the semiconductor device **as in claims 21 and 23**.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

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May 2, 2003

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TECHNOLOGY